ADDIS ABABA SCIENCE AND TECHNOLOGYUNIVERSITY
SCHOOL OF GRADUATE STUDIES

Concrete and Concrete Making Materials Wastage Minimization in Construction of Housing project in Bole Bulbula site

A Project submitted to the School of Graduate Studies of Addis Ababa Science and Technology University in Partial fulfillment of the requirements for the Degree of Master of Engineering in Civil Engineering (Construction Technology and Management)

By

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APPROVAL PAGE

This project entitled with'' **Concrete and Concrete Making Materials Wastage Minimization in Construction of Housing project in Bole Bulbula site** '' has been approved by the following examiners in partial fulfillment of the requirement for the degree of Master of Engineering in Civil Engineering (Construction Technology and Management).

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EXCUTIVE SUMMARY

One of the wide ranging problems that the construction industry is facing is the wastage of construction inputs. This major problem is spread all over the country and domestic contractors are critically affected. Moreover the projects' performances are also affected against cost and quality.

Construction materials wastage management is an important element in the management of construction projects. One of the construction materials widely used in construction projects is concrete. Concrete being one of the important constituents of many of the construction projects, in addition to its subjectivity to variability, requires a close and thorough care and handling in construction projects.

An attempt is made in this paper to identify concrete and concrete making material waste and locate causes of its generation in housing projects at Bole Bulbula site. The project study observations are derived from the interview data analysis of ten contractors' and two consultant's professionals located at the housing project. According to the result found from the survey study, 100% of the stakeholder's respondents believe that; the existence of concrete and concrete making material wastage problem in Bole Bulbula Housing Construction projects.50% of the interviewer's indicated seven determined problems are caused due to lack of proper structured wastage management plan before starting construction and they also mitigate there ideas how to minimize that wastage.

From my observation, material wastage is mostly created due to utilization, poor workmanship, design problem, improper material handling and storage system. Following this identification, proper methods are proposed to mitigate the generation of wastes by adopting proper construction and management wastage methods, which allow the waste reduction from using concrete making materials.

Finally, I recommend the stockholders must have taken the guideline to design waste management plan.

CHAPTER ONE

1. Introduction

1.1. Back ground of the study

The construction industry, one of the vital constituents of any country's economy contributes about 10% of the gross domestic product (GDP). This showed a growth rate of 1.8% worldwide in 2001 [2]. This growth in construction activities increases the amount of construction waste generated [1].

According to [3], construction materials account for the largest in put into construction activities, in the range of 60 - 70%of the total project cost. Unfortunately, this large portion of materials is not wholly utilized by the industry.

Evidence shows that approximately 40% of the waste generated globally originates from the construction and demolition of buildings and this forms a major portion of the solid waste discarded in landfills around the world [9].

Due to lack of consideration given to waste generation reduction strategies during planning and design stages, estimators often plan for extra construction materials [6].

Construction managers have often failed to identify or address waste problem in the construction processes because of lack of appropriate tools for measuring them [4].

Besides, wastage on construction projects might take about 5% of the total budget of the project and this in turn significantly affect the contractor’s profit since they usually operate within a tight 10% profit margin.

Therefore, a small saving in materials cost through efficient material management can result in a better profit margins and better resource utilization thereby reducing environmental impacts.

Accordingly, this paper tries to discuss the wastage related issues of building construction in Addis Ababa, particularly in Bole Bulbula site.

1.2. Statement of the problem

Construction site waste contributes to the large quantities of construction wastes that are generated by the construction industry every year. It is estimated that on average construction waste constitutes 15-30% of the total amount of waste that ends up in landfill sites in many countries. At project level, the waste generated on site has been estimated to be about 10% of the materials originally purchased. Many builders realize that many materials that are wasted on the jobsite result in two cost factors i.e. the material procurement cost and the waste disposal cost. Although the waste disposal costs of construction site waste form as little as 0.5% of the total budget of a typical home, contractors realizes that this cost can significantly affect their profit since contractors generally operate within a tight 15% profit margin[1].

In Ethiopia, most of the materials purchased are not fully used during construction and this indicates that the leftovers may remain as waste that may not be accounted for improper control of materials during different stages of construction has caused waste and associated environmental problems [10].

Hence, this paper aimed to identify the causes, effect and factors incidental to concrete and concrete making material waste and measures to effectively control or minimization mechanisms of waste.

1.3. Objective

1.3.1. General Objective

The objective of the project is to identify the major attributes of concrete and concrete making material wastes on housing projects in Bole Bulbula site and to purpose the possible measures of minimizing their occurrences. It was specifically limited to material wastes because materials are the most wasted resources on construction sites[10]. The materials we considered were concrete, concrete making material because; i) These materials represent a significant percentage of the total cost of building in most built housing building in Addis Ababa; ii) They tend to have a high percentage of waste on most sites and iii) They are the most commonly used construction material in Ethiopia [10].

Therefore, providing practical suggestions and recommendations aiming to minimize concrete and concrete making materials waste is important.

1.3.2. Specific Objectives

- Assessment of the causes of concrete and concrete making material wastages
- Assessment of the effects of concrete and concrete making material wastages
- Indicate the wastage minimization mechanism.

1.4. Scope of study

The scope of this paper bases only on Addis Ababa Housing projects the case of in Bole Bulbula condominium site. The materials we consider are concrete, and concrete making materials such as cement, fine aggregate (sand) and coarse aggregate only. Accordingly, analysis was made on:

- The major and regular causes of wastage
- Effects of wastage
- Wastage minimization mechanisms

1.5. Limitations of study

The major limitations of this paper are:

- Contractors' representatives reservation to provide full information about the cause and effect of wastage on concrete and concrete making materials
- Lack of sufficient recent recorded data that indicate the effect of construction materials wastage in Ethiopian
- Lack of onsite record of wastage materials to quantify the wastage impacts on the project.

CHAPTER TWO

2. Literature review

This chapter deals with definition, classification, causes and effect and minimization mechanisms of concrete and concrete making materials wastage.

2.1. Definition of waste

A number of definitions of waste are available. According to the new production philosophy, waste should be understood as any inefficiency that results in the use of equipment, materials, labor, or capital in larger quantities than those considered as necessary in the execution of the work. Waste includes both the incidence of material losses and the execution of unnecessary work, which generates additional costs but do not add value to the product [1].Waste should also be defined as any losses produced by activities that generate direct or indirect costs, but do not add any value to the product from the point of view of the client [2]. A simple way to define waste is "Anything which can be eliminated without reducing customer value". It can be activities, resources, rules, etc. The common sense understanding of waste is anything without value. More precisely, waste is the expenditure of effort or the using-up of resources without producing value [3].

2.2. Construction waste

Waste has been considered to be a major problem in the construction industry. Waste in construction is not only focused on the quantity of waste of materials onsite, but also related to time waste. Waste in the construction industry has been the subject of several research projects around the world in recent years. Some of them have focused on the environmental damage those results from the generation of material waste. On the other hand, there have been a number of studies mostly concerned with the economic aspect of waste in the construction industry [2]. All those activities that produce costs, direct or indirect, and take time, resources or require storage but do not add value or progress to the product can be called non value – adding activities or waste [1]. Waste in construction is not only focused on the quantity of waste of materials on-site, but also related to several activities such as overproduction, waiting time, material handling, processing, inventories and movement of workers [2].

Construction site waste can be described as the non-hazardous byproduct resulting from activities during new construction and renovation. It is generated during the construction process because of factors such as site preparation, material use, material damage, material non-use, excess procurement and human error [7].

According to the Environmental Protection Department (EPD), Construction waste defined as: Construction waste comprises of unwanted materials generated during construction, including rejected structures and materials, materials which have been over ordered or are surplus to requirements, and materials which have been used and discarded [4].

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- Overproduction,
- waiting time,
- material handling,
- processing,
- Inventories and Movement of workers [2].

2.3. Types of construction waste

There are two types of waste in construction; waste in material and waste in time.

2.3.1 Time waste

Time waste is a type of construction waste which covers all duration that does not add value. The duration of construction tasks consists of process (and reprocess or rework) time, inspection time, move time, and wait time. Only process time is considered to be value adding activity. The reminders are non-value adding activities [1].

However, all value adding time belongs to process time, not all process time is value adding. Processes are also subject to wastes resulting from overproduction, wrong construction method, defects, and poor optimization in performance tasks [8].

2.3.2 Material waste

Building material waste can be defined as the difference between the value of materials delivered and accepted on site and those properly used as specified and accurately measured in the work [11].

It could also be defined as any material, apart from earth materials, which needs to be transported elsewhere from the construction site or used within the construction site, other than the intended specific purpose of the project due to material damage, excess, non-use, or noncompliance with the specifications or being a by-product of the construction process [11].

This paper will focus on material wastage on concrete and concrete making materials.

2.4. Classification of waste on Concrete and Concrete making materials

Waste on concrete and concrete making materials can be broadly classified as direct waste and indirect waste.

Direct waste: consists of loss of materials, due to the fact that they are irreparably damaged or simply lost. Direct waste is the loss of concrete and concrete making materials, which were damaged and could not be repaired and subsequently used, or which were lost during the building process. The major types of direct wastes can be summarized as follows:

- **Residue waste**: occurs when completely not used and when not properly sealed especially on cement.
- **Stockpile waste:** when most loose concrete making materials are dispersed on the site because of poor storage.
- **Criminal waste:** Occurs due to theft and vandalism.
- **Management waste:** Occurs due to lack of supervision or incorrect decisions of the management.
- **Waste due to wrong use:** Occurs due to wrong selection of materials.

Indirect waste occurs when materials are not physically lost; causing only a monetary loss for example, waste due to concrete slab thickness larger than specified by the structural design. Indirect waste arises principally from substitution of materials, from use of materials in excess of quantities allowable under the contract, and from errors.

The major types of indirect wastes can be summarized as follows:

- **Substitution waste:** Occurs when the previously purchased materials are substituted by new materials due to inferior quality or interest of the client.
- **Production waste:** Occurs when contractor does not receive any payments for the works he has carried out.
- **Operational waste:** Occurs due to unavailability of proper quantities in the contract document and when the materials are left in the construction site.
- **Negligence work:** Occurs when more materials are used than specified, due to the unfit machineries and workmanship.

2.5. Waste generation causes in the construction site

It is possible to mention several reasons for the generation of construction waste. However, first of all, it is necessary to state that most of these reasons are due to **human errors** occurring at different stages of a construction process. Some researcher, Identify the reasons of waste as follows, "design, procurement, handling of materials, operation, residual waste and others" [6].

Table 2.1. Summary of waste generation causes

Type	Cause
Design	Error in Contract Document
	Incomplete Contract Document during commencement
	Changes made to the design while construction is in progress
	Lack of attention paid to standard size available on the market
	Lack of detailing in the drawing
	Selection of low quality products
Procurement	Ordering error, over ordering and under ordering
	Lack of possibilities to order small quantities
	Use of products that do not comply with specification
Material handling	Damages during transportation to site/on site
	Inappropriate storage
	Unfriendly attitudes of project team and laborers
Operation	Equipment malfunction
	Accidents due to negligence
	Use of incorrect material, thus required replacement
	Required material unclear due to improper planning
	Delay in passing of information to the contractor (types and sizes)
	Workmanship problem, Capacity and attitude
	Inclement weather

2.6. Effects of material wastage

Construction process wastes produce no benefits but only costs to the stakeholders. It creates economic and environmental harm and health problems.

2.6.1 Effects of material wastage To the Client

Industry researchers and practitioners acknowledge that there are many wasteful activities during the design and construction process. Waste finally consumes resources and time without adding value for the client. But client is the one who is going to pay for this waste either totally or partly.

2.6.2 Effects of material wastage To the Contractor

The cost of wasted material is not only its value. It includes the cost of disposal including handling, transporting and tipping charges and cost of consequential losses. Thus it's more than we realize.

2.6.3 Effects of material wastage To the Environment

Environmental harm is another critical feature of waste. Construction uses many materials extracted from deposits in the earth's crust. In using materials on a large scale and due to the waste, construction contributes to depletion of non-renewable resources.

2.6.4 Economic effect of material wastage

Significant economic and environmental benefit can be gained by controlling and managing building construction waste. Waste minimization practice can also increase the competitiveness of contractors through lower production cost and a better public image

2.7. Concrete and Concrete making Material wastage in construction site

Since the major concrete ingredients are cement, fine aggregate (sand), course aggregate and water, identifying the intensity and causes of wastage onthese materials is critical for the economical execution of the construction project.

2.7.1 Cement

Cement is the most expensive ingredient of the concrete and also sensitive to damage. Therefore, attention should be given to the following major and common causes of cement wastage.

- Failure to purchase the identified type of cement (PPC, OPC, PLC)
- Failure to cover the cement during transportation (rain)
- Carelessness during loading and unloading
- Problem in storage
- During utilization of cement from store not as per the principle of FIFO (First in First out) which might lead to expiration
- Mishandling during in-situ concrete mixing

2.7.2 Sand

In current Ethiopian construction, the source of sand is river. Thus, the qualities of the sand collected from the river usually differ since it depends on the location (source) and season.. Some of the quality criteria of sand are grading, silt content; most sands supplied to the market miss one or both of the quality criteria.

Therefore, attention should be given to the following major and common causes of fine aggregate wastage.

- Poor quality of sand supply to the site
- Poor stockpiling on the construction site
- Wastage due to the washing of sand (in order to minimize silt content)
- Loss due to transportation especially fine sands
- Payment to the wet sand that has a high bulking volume

2.7.3 Coarse Aggregate

The major ingredient of concrete is Coarse aggregate; it covers from 60-75 % of the concrete. In Ethiopia, especially in Addis Ababa, there is a shortage of course aggregate in relation to the projects taking place [10]. As a result, the Contractor has no alternative to choose the course aggregate which satisfy the quality requirements. In addition to supply shortage case which is the source of poor quality, attentions should also be given to the following major and common causes of course aggregate wastage.

- Poor quality of course aggregate supplied to site
- Poor stockpiling on the construction site
- Excess wastage due to loading to the box on site mix
- Due to contamination with soil and other material
- Purchase excess than the required because difficult to purchase small amount

2.7.4 Concrete

There are two types of mixed concrete, concrete ready mixed (premixed concrete) and concrete site-mixed [12]. In our case, we will consider the concrete wastage that is caused as a result of concrete mixing on site. In most building construction in Addis Ababa, there isa lot of concrete wastage observed on projects since a concrete casting process is done manually.

On projects, which concrete casting done by concrete pumping equipment, the wastage of concrete observed on site is less. So we can say most of the wastage of concrete happens during the concrete casting operation.

The major causes of concrete wastage as follows [12],

- Deviations in the dimensions of cast-in-place structural elements (slabs, beams, and columns) are an important source of concrete indirect waste.

- Waste of concrete was during the handling and transportation operations onsite, mostly related to site layout problems, the path from the mixing location to the casting location and to the use of in adequate equipment for transport.
- Due to uncertainty related to material consumption, site engineers often order an additional allowance of concrete mixing in order to avoid interruptions in the concrete-pouring process.
- Methodology of pouring isn't good especially for narrow structural sections.
- Area of mixing isn't clean due to this concrete will contaminate with other unnecessary materials.
- Poor quality that created during casting operation like honeycomb.
- Use of aged timber board or steel panel which results concrete leakage
- Excess load
- Using high slump concrete

2.8. Minimizing waste on construction projects

Waste minimization is defined as: Any method that reduces the volume of a waste that requires disposal. In a practical sense, it is any method that reduces the amount of waste [11]. Government regulations, as well as internal cost effectiveness, require that the production and disposal of all wastes, and particularly hazardous wastes, be kept to a minimum.

The building industry is using a considerable amount of resources, but if the life cycle of the material on site is closely examined, it is generally known that there is a relatively large portion of the materials being wasted because of poor material control on building sites [9].

Practical waste minimization strategies require a detailed understanding of what causes construction waste [13]. Other researcher examined waste minimization strategies and the relative significance of construction waste sources using survey [14]. Furthermore, while a majority of firms with specific waste minimization policies made efforts to minimize waste at source such as to avoid generating waste in the first place, this minimization was limited to waste generated by site offices and amenities [14].

According to the researcher's, the significant contribution to waste reduction in the construction industry is through people changing their wasteful behavior. Waste is an inevitable by-product of construction activity; its management is a low project priority with an absence of appropriate resource and incentives to support t [13].

Some of the waste minimization measures identified from literature

- Purchasing of concrete making materials that are just sufficient
- Using materials before expiry dates
- Use of more efficient construction equipment
- Good coordination between store and construction personnel to avoid over ordering
- Adoption of proper site management techniques
- Training of construction personnel
- Accurate and good specifications of materials to avoid wrong5 ordering
- Proper storage of materials on site
- Checking materials supplied for right quantities and volumes
- Employment of skilled workmen
- Minimizing design changes
- Change of attitude of workers towards the handling of materials
- Accurate measurement of materials during batching
- Mixing, transporting and placing concrete at the appropriate time
- Access to latest information about types of materials on the market
- Vigilance of supervisors
- Weekly programming of works
- Good construction management practices
- Adherence to standardized dimensions
- Waste management officer or personnel employed to handle waste issues
- Just in time operations
- Early and prompt scheduling of deliveries
- Encourage re-use of waste materials in projects
- Discrepancy in drawing and specification
- Avoiding Variations on the design during Construction (especially demolishing)

CHAPTER THREE

3. Methodology

In this project the primary data was obtained from archival document and survey using interviews, desk study and site visit.

Interviews were conducted to complement the questionnaires. Personal interviews were conducted to complement the questionnaires administered to the respondents. The interviews were conducted among construction personnel namely builders, engineers and foremen by covering issues related to the order of site activities, waste handling methods, problems of waste minimization, waste reduction measures and likely suggestions to avoid and minimize waste. Site visits were carried out to physically identify the methods used at the construction sites to manage streams of waste generated.

3.1. Background

For this particular paper, we had made a site visits, conduct interviews and discussions with Contractors' and Consultants' senior staff who are participating on the construction of Bole Bulbula Condominium site. The condominium site on progress will accommodate around 25,000 people.

The construction works had been executed by different Contractors. And during my site visit, I tried to identify and record causes of wastage on concrete and concrete making materials.

Besides, I had made interview and discussions with the Contractors' and Consultants' representative regarding the wastage minimization techniques that the Contractor has been taken and plan to take.

3.1.1. Analysis Profile of the Interviewed Questions

As discussed in the methodology part of this review, the approach to assess the existence of concrete and concrete making material wastage problems, the main causes of wastage, their side effects and proposed methods is the use of interview and Observation survey based on Professional Experience. The interview questions were designed to collect data regarding the current material management and wastage control practices.

The questions were ground into four major sections. The sections and their area of assessment are the followings:

Section one is related to the existence of concrete and concrete making material wastage problem in Building Construction projects.

Section two is designed to assess the major causes for concrete and concrete making material wastage. Wastage resulting during design and supervision, procurement, handling and storage and during utilization of materials has received a particular attention.

Section three is designed to assess the common side effects of the problems on both stakeholders and projects.

Section four is related to the system proposed by stakeholders to minimize concrete and concrete making material wastage in the Building Construction projects.

The respondents

The respondents were local contractors and consultants engaged mainly in Building Construction projects. A total of interviews were made. The respondents have been asked to respond questions in relation to their firm as well as Project material management practices and any pre identified causes of wastage in projects, if there is any. Respondent's reaction was positive. The table summarizes the number of interviewers.

Table 3.1.**Summary on the response rate of interviews**

Construction party	No of interview
Contractors	10
Consultants	2
Employers	1

Data Presentation, Analysis and Discussion

Section one – is related to the existence of concrete and concrete making material wastage problem in Bole Bulbula housing projects.

Table 3.2.Existence of concrete and concrete making material wastage problem

Item No	Questions	Respond	Respondents	
			In No.	In %
1	Is there any Concrete and concrete making materials wastage problem directly connected to Building construction projects? Yes or No			
	Contractor	Yes	10	100
	Consultant	Yes	2	100

The above Table indicated that the existence of material concrete and concrete making material wastage problem in Bole Bulbula Housing Construction projects. Accordingly to the result found from the survey study, 100% of the stakeholder's respondents believe that; the concrete and concrete making material poor handling and wastage problem exist in building construction Project.

Section two is designed to assess the major causes for concrete and concrete making material wastage. Wastage resulting during design and supervision, procurement, handling and storage and during utilization of materials has received a particular attention.

Table 3.3.Major causes of concrete and concrete making material wastage.

Item No.	**Questions**	**Respondents**	
		In No.	**In %**
2	What are the major cause of Concrete and concrete making materials wastage in Bole Bulbula Housing Construction projects?		
	1. Poor workmanship		
	Contractor	5	50
	Consultant	**2**	**100**
	2. Improper material handling and storage system		
	Contractor	**8**	**80**
	Consultant	**2**	**100**
	3. Utilization		
	Contractor	**4**	**40**
	Consultant	**2**	**100**
	4. Design problem		
	Contractor	**10**	**100**
	Consultant	**1**	**50**
	5. Variation in design at construction stage		
	Contractor	**8**	**80**
	Consultant	**1**	**50**
	6. Incorrect procurement of materials		
	Contractor	**6**	**60**
	Consultant	**1**	**50**
	7. In bulk material supply by the owner		
	Contractor	**9**	**90**
	Consultant	**2**	**100**

3.2. Cause of wastage

As per the observation and the discussion made with the site foremen, more than 50% of saysthe major causes of wastage on concrete and concrete making materials are:

1 Poor workmanship
   - Wastage due to Poor workmanship especially mason and carpenter: during placement of concrete and construction of loose formwork.
   - Carelessness of Sub contractors

2 Improper material handling and storage system
   - Wastage due to improper Stockpiling
   - Wastage during temporary storage of cement
   - Wastage due to Theft
   - Lack of onsite materials control
   - Lack of quality management system aimed at waste minimization

3 Utilization
   - Wastage during mixing concrete by hand(using spade)
   - Shortage of technical professionals in the Contractor's organization.
   - Using excessive quantities of materials more than the required

4 Design problem

5 Variation in design at construction stage
   - Additional material requirement for Correction works
   - Wastage due to Congested working environment

6 Incorrect procurement of materials
   - Wastage due to poor transportation of raw materials
   - Rejection of material

7 In bulk material supply by the owner

Generally, above 50% of the interviewer's state the above determine problems are caused due to lack of proper structured wastage management plan before starting construction. Since the government is spending a high amount cost in this building construction projects, the Stakeholders must have to control that minimizes construction material wastage from design up to commissioning of all public and commercial building constructions. In addition the governments have to force both contractors and consultants in bid signing time in order to employ experienced professional engineers in each specific project for quality work and for proper implementation of wastage minimization policies.

3.3. Effects of Material Wastage

Section three is designed to assess the common side effects of the problems on both stakeholders and projects.

As per discussion with Contractors' representative at site and my observation, the major side effects of material wastage are:

1. **Low Profitability**

   As per the discussion with the Contractors' representatives, the profitability of a project can be influenced by the cost of materials. Large costs can be saved from the materials since it contribute to a substantial value of a project. Therefore, I can conclude that, the higher the level of wastage, the lower the profitability. For that reason, proper material storage and management is needed to maximize profitability of a project.

2. **Delay in project completion time**

   During my discussion with the project engineers, the delay of construction work will occur due to wrong types or poor quality of materials are used. As a result additional time required for the re-works and substitution of materials.

3. **Low productivity**

   It is straight forward that poor material storage management will affect productivity. For example a congested site with materials not properly allocated will create a lot of double handling works and obstruct the execution of physical work. Consequently, the productivity of the works will be reduced with shortages and delay of material supply that disrupt the program.

4. **Environmental Impact**

   Wastes due to materials poor handling will easily affect the environment. The impact of construction operations on natural conservation is cumulative and collective in most situations, such as disturbance of sensitive habitats and species by water pollution. In addition, where large amounts of wastes are generated, loss of grassland can result from the need for landfill sites.

3.4. Possible mitigations to reduce wastage problem

Section four is related to the system proposed by stakeholders to minimize concrete and concrete making material wastage in the Building Construction projects.

As per the interview and discussions made with the Contractor's and Consultant's representative, the Contractor has been taking and plan to take the following measures so as to minimize wastage on concrete and concrete making materials:

- The contractors are planning to use ready mix concrete jointly to reduce a result concrete wastage during mixing.
- Wastages caused during transportation of concrete will be reduced by using pulleys and cranes.
- Improving site facilities such as construct and regularly maintaining access roads, constructing warehouses which avoid cement contact with floor & wall and guard towers.
- Conducting material quality tests before procurement
- Avoiding demolishing, re-works and correction works
- Assigning a qualified carpenter and mason
- Using proper formwork
- Use of materials only from approved sources and conducting a routine quality tests before mobilization to site.

3.5. Site observation Pictures

Fig. 1: Rejected Material (Sand)

Fig. 2: wastage during storage of Cement

Fig. 3: Wastage during transportation of concrete

Fig. 4: wastage during placement

Fig. 5: Wastage during material stocking (mixing of materials)

Fig.6: Wastage during site mixing of concrete

CHAPTER FOUR

4. Conclusion and Recommendation

This chapter includes the conclusion and the practical recommendations that may help to minimize concrete and concrete making materials waste in building construction projects in Bole Bulbula housing project.

4.1. Conclusion

From the above site observation, literature review and indicate to the attached figure, I conclude as follows:

- For most projects, the actual consumption usually exceeded the designed consumption
- The workers have very low knowledge about concrete and concrete making material waste reduction techniques.
- Lack of training regarding material handling.
- Lack of qualified workers is a major cause of concrete and concrete making materials waste.
- Managerial problems in stages that precede production are among the most important causes of waste. These include lack of optimization during design in the use of resources lead to, mistakes in the procurement of materials and waiting to replacement or ordering additional materials, lack of stocking of materials and poor communication with the construction parties.
- There is no Waste management system.
- Most contractors do not have an appropriate form to calculate and record total wastage.
- The contractor and Client do not use proper material delivery system.

From observation, material wastage is mostly created due to utilization, poor workmanship, design problem, improper material handling and storage system.

4.2. Recommendation

I would like to recommend all the parties involved in the construction should take the under listed measures so as to minimize concrete and concrete making material waste in building projects in Bole Bulbula housing project.

4.2.1. Clients

Clients play an important role in reducing the quantities of concrete and concrete making materials waste by the following:

- Asking contractors to prepare and submit an acceptable waste management plan matching with the nature of the project.
- Owners should take the waste management history of the contractors form their past performance as a criterion in awarding contracts.
- Regulating visits to construction site at all critical stages during the project period.
- Has to regulate the wastage on materials supplied by the Client (like cement, coarse aggregate, etc) by providing feasible material usage standard.
- The client should regularly follow the quality of the work since the Contractors might try to compensate the wastage by compromising the quality.

4.2.2. Designers/Consultants

Designers play a key role in reducing the quantities of concrete and concrete making material waste by:

- Careful attention to detail at the design and planning stages to avoid design and planning errors.
- Optimization during design in the use of resources.
- Reviewing the project specifications by the contractor at the construction stage to detect design, detailing or other errors.
- Design spaces to be flexible and adaptable to changing uses. This avoids creating waste during remodels.
- Advising the contractor to implement wastage minimization techniques

4.2.3. Contractors

Contractors play a key role to reduce concrete and concrete making materials waste in construction process. Contractors' contribution to wastage depends on the stage of construction like operation, material handling, and etc. Thus, by taking it in to consideration, I would like to recommend the contractors as follows:

1. **Operation**

- To assign qualified staff and workforce in construction projects.
- Preparing waste management plan to minimize the waste.
- Working with all suppliers to reduce waste on a project by asking them to buy back unused material.
- To apply waste management system on site by gathering and recording data about waste on site.
- By assigning quality control crew, minimize rework caused by errors and poor workmanship.
- Set specific waste reduction goals for each project and frequently check its application in relation to the target.
- Monitor the success of the program and potential barriers by including a discussion about the waste reduction program during the project meetings.

2. Material Handling

- Preparing monthly materials re-conciliation statements should be made mandatory to all projects.
- Ensure storage areas are safe, secure and waterproof.
- Don't remove protective packaging from materials before they are needed.
- Proper stocking area
- Taking care during loading and unloading
- Separate stocking for different materials

3. Procurement

- Avoid over-ordering.
- Arrange deliveries to match work stages, to avoid materials being stored on site longer than necessary.
- Don't accept poor quality or damaged deliveries.
- using only approved source for materials

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APPENDIX

Interview Questions for Contractors

1. Is there any material handling and wastage problem directly connected to the Building construction

   Yes ☐ No ☐

2. If the answer is yes, what are the consequences?

   A) Cost overrun,

   B) Delays of project completion time.

   C) Ineffective material resource utilization

   D) Environmental impact

   E) Please, brief all how it affects

_____

_____

_____

3. Is there any material handling problem and causes for construction material wastage due to delivery of construction material in bulk amount to the site by the client?

   Yes ☐ No ☐

4. If yes, please mention the impacts of its influence?

_____

_____

5. In your opinion, which creates cost overrun and delays on project completion time due to material wastage and poor material handling?

   A) Over design during design period,

   B) Contractor's negligence,

   C) Delay in material section and approval,

   D) Delay in material supply by the owner,

Please, brief how it affects.

_____

_____

6. What is your opinion, on the effect of workmanship quality during utilization of materials on site with respect to wastage of construction materials?

_____

_____

7. Lack of sufficient stock area for construction materials on site, could it be a cause for material wastage?

Yes ☐ No ☐

8. If yes, how it will be modified?

_____

_____

9. What are the major causes that enhancing material wastages in your company?

A) Lack of appropriate attention for handling and storing.
B) Poor workmanship at site,
C) Improper material procurement
D) Inexperienced project managers
E) Variations in design at the construction state (demolishing),
F) Delay in material selection and approval,

_____

_____

10. What kind of methodology you adopt to your company for minimizing material handling and wastage problems?

Interview Question for Consultants

1. Is there any material handling and wastage problem during your design and supervision?

   Yes ☐ No ☐

2. If your answer is yes, what problems your companies observe during design period?

_____

_____

3. If your answer is yes, what problems your companies observe during supervision period?

_____

_____

4. Based on question no 1, is there any remedial measures taken by your company to resolve problems, if problems come into view?

_____

_____

5. Is there any design modification made by your company to reduce material wastages

   Yes ☐ No ☐

6. If your answer is yes, please describe it?

_____

_____

7. What are the major causes that enhancing material wastages in your company?

   A) Over design,

   B) Dimension dis- coordination during design stage,

   C) Variations in design at the construction stage (demolishing

   D) Inexperienced project supervisors

   E) Delay in material selection and approval,

   F) Resistance to adopt alternative materials

_____

_____

8. In your observation, which one lead to create maximum material wastage

   A) Contractors negligence,
   B) Poor workmanship at site,
   C) Improper material procurement
   D) Delay in material selection and approval,
   E) Unconcerned supervisory staff,

Please circle one or two and illustrate

_____

_____

9. What kind of methodology and system you adopt to your company, in minimizing material handling problem and wastage controls

_____

_____